YouTube Link: <https://www.youtube.com/watch?v=A5_rWVLznWo>

User and Product Manual Instructions

This document is a template of a user and product manual. The client may wish to make improvements on the prototype or need to fix it if something goes wrong or another group of students may work to make a more rugged prototype. The document needs to be clear for someone else who is not an engineer **to use, maintain or reproduce the project**. Include as many images and diagrams as possible for a better understanding. Keep it plain, simple, visual and logical.

In general, if you are not sure exactly what to include, imagine that this document was the only thing that you had. Imagine also that your job was to add a new feature or recreate the project that is described in your document. What would you need to know?

Only include details relating to your final prototype.

Template conventions:

* Remove all red text, it is only there to guide you
* Remove this page (instructions)
* Replace all instances of <xxx> with the appropriate information for your group, for example you could replace <System Name (Acronym)> by The Amazing Product (TAP)
* Save this document as ‘User and Product Manual\_group number’ instead of Deliverable X so that others know what it represents when they see it in MakeRepo

GNG 2101

Design Project User and Product Manual

Powered Grabber Group 2.4

A logo of a device

Description automatically generated

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List of Acronyms and Glossary

Table 1. Acronyms

|  |  |
| --- | --- |
| **Acronym** | **Definition** |
| CAD | computer-aided design |
| DC | direct current |
| IDE | integrated development environment |
| USB | universal serial bus |

Table 2. Glossary

|  |  |  |
| --- | --- | --- |
| **Term** | **Acronym** | **Definition** |
| integrated development environment | IDE | Software application that helps programmers write their code |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# Introduction

This report presents the design and development process of our mechanical gripper prototype, aimed at helping young children with limited grip mobility skills to perform daily tasks independently. Several key assumptions were made during development, such as the device's ability to support specific weights and the safety of its mechanical and electrical components. These assumptions guide our testing and design choices, ensuring the gripper remains both durable and user-friendly.

The document is structured to provide a comprehensive overview of the project, starting with an analysis of Prototype 1, followed by peer feedback and an overview of team dynamics. Each section describes the assumptions, testing methodologies, and evaluations that informed our design iterations. The scope includes prototype evaluations, project progress presentations, and a detailed description of the DFX principles we followed, with a particular focus on security, usability, and reliability.

The purpose of this document is to follow the evolution of our project from initial assumptions through design constraints and prototype improvements, to final prototype evaluation and design day presentation. Each section reflects our team's commitment to developing a functional and inclusive tool that meets both user needs and manufacturing considerations, to make a successful product.

This User and Product Manual (UPM) provides the information necessary for young children with limited grip mobility skills, caregivers and educators to effectively use the Snatch It and for prototype documentation.

# Overview

**Problem Statement and Significance**

Children with limited hand movements often face challenges in performing daily tasks such as picking up objects. These limitations can hinder their independence, leading to frustration and dependence on others for assistance. This project addresses this problem by designing a lightweight, automated grasping tool to empower children, promote inclusion, and reduce the workload of caregivers and teachers.

**Basic User Needs**

* Independence: Allow children to pick up objects without outside assistance.
* Ease of Use: Simplify use to accommodate limited mobility and dexterity.
* Safety: Ensure the product is safe and free from potential hazards during use.

**Product Differentiation**

Our grabber tool is distinguished by:

* Low-sensitivity activation: Minimal force required to operate.
* Ergonomic Design: Lightweight and easy for children to handle.

Durability: Built with repairable and environmentally friendly materials to reduce waste.

* Pressure Sensor Integration: A sensor at the tip of the gripper prevents damage to delicate objects by automatically controlling the gripping force.
* Rechargeable Batteries: Eco-friendly and economical, the gripper uses rechargeable batteries that come with a charger for convenient reuse.
* Movable Button: The activation button can be repositioned along the gripper, allowing for customization for each user's comfort and accessibility.
* 3D Printed Design: The handle and claw parts are 3D printed, ensuring lightweight construction, durability, and customizable designs.

A person sitting at a table with a poster board

Description automatically generated

A table with a poster and an object on it

Description automatically generated

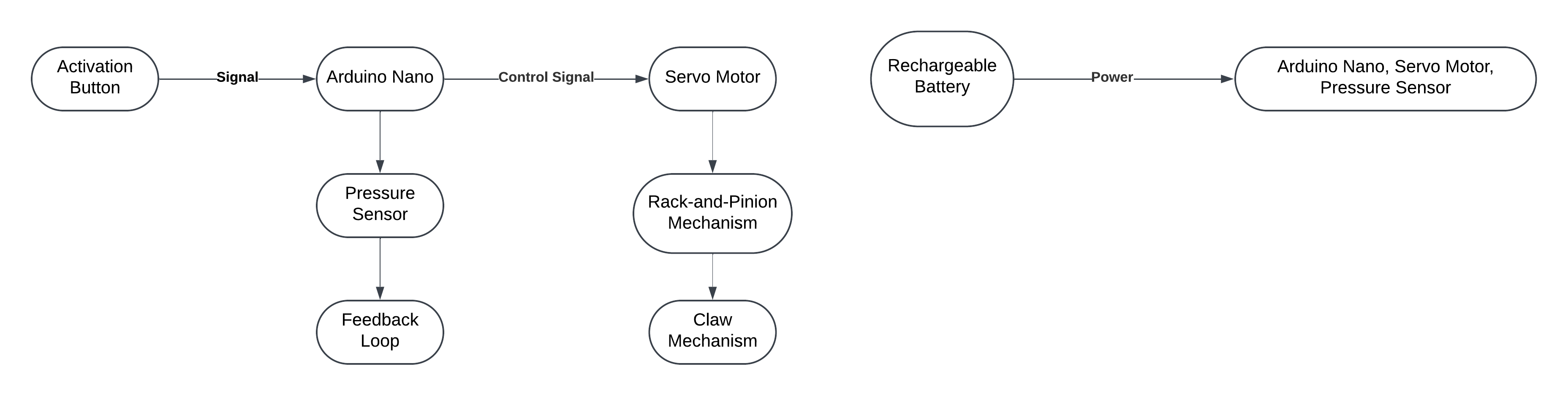
Figure 1: Powered grabber

**Key Features**

* Automated Claw Mechanism: Grips and releases objects with precision and safety.
* 3D Printed Ergonomic Handle: Custom-designed for lightweight use and a comfortable grip.
* Durable and Portable: Built with sturdy materials and designed for easy carrying.
* User-friendly rechargeable battery system: Environmentally friendly and convenient for daily use.

**System Architecture and User Access**

* Construction:
* Frame: Lightweight aluminum or durable plastic for portability and strength.
* Mechanism:
* Microcontroller: An Arduino Nano board controls the system.
* Actuation: A servo motor drives a rod attached to a rack-and-pinion mechanism, enabling the claw to open and close.
* Pressure Sensor: Ensures safe handling of objects by adjusting grip force.
* Handle and claw: 3D printed for ergonomic and personalized use.
* User Access:
* Activation: Operated via a repositionable button for flexible use.
* Power: Rechargeable battery system with included charger for easy reuse.
* Assembly: Simple setup; components can be unfolded and configured as needed.
* Special Conditions: Designed for safe and efficient indoor use with minimal maintenance.



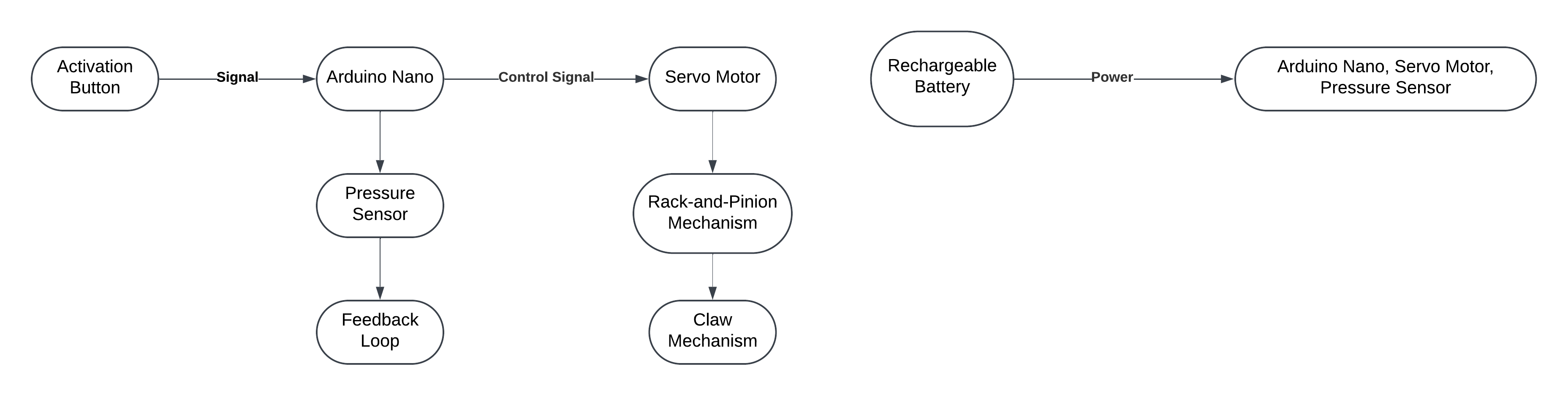


Figure 2: Operations flowchart

## Conventions

Action Lines: Instructions requiring user actions are indicated by “Action:” followed by steps.

Key Terms: Important terms are highlighted in bold for clarity.

## Cautions & Warnings

Caution: Turn off the grabber when not in use to avoid accidental activation.

Warning: Do not use the grabber for handling sharp or hazardous objects.

Battery Safety: Use only the provided charger to recharge the batteries, ensuring safety and device longevity.

Permission for Use: Written permission is required to replicate this design

# Getting started

## Configuration Considerations

The grabber does not require any special types of tools or connections to be made to configure it. The user only needs their hands to operate the device for its normal intended use case, which is to pick up, transport and release objects.

## User Access Considerations

The two primary different types of users and/or user groups that would use the prototype are children and their adult supervisors:

Child Users: The children will use the grabber to make everyday objects easier to reach, providing them the ability to reach their toys independently without the help of others. This type of user should only interact with the button which opens and closes the claw.

Adult Supervisors: The adults will ensure that the children are using the grabber responsibly and safely. This type of user is permitted to perform simple maintenance tasks such as swapping the batteries in the battery holder, recharging batteries with the included charger and removing the lid of the handle if required.

## Accessing/setting up the System

Step 1: To set up the grabber, locate the power switch at the base of the handle. Turn the switch on to allow for the grabber to open and close the claw.



Figure 3: Location of power switch

Step 2: Adjust the activation button of the grabber by using the velcro that is attached to the handle and base of the button. Place the button in the position that is best suited for personal comfort and ease of use.

A hand holding a green toy object

Description automatically generated

Figure 4: Select location of activation button

Step 3: The claw will open and is now ready to be positioned to pick up your desired object.

A hand holding a green handle

Description automatically generated

Figure 5: Open claw

Step 4: Position the claw around the object you would like to pick up and press the button to close the claw.

A can with a green tag attached to it

Description automatically generated

Figure 6: Claw around the object to be picked up

Step 5: The pressure sensor will cause the claw to stop closing once contact has been made with the object. You may now lift the object and transport it to your desired end location.

A can falling into a machine

Description automatically generated

Figure 7: Lifted object

Step 6: Once positioned, click the button to open the claw and release the object.

A can in a hole in a yellow box

Description automatically generated

Figure 8: Claw opening and object being released

## System Organization & Navigation

A green and black device with a handle and a can of soda

Description automatically generated

Figure 9: System Organization

The image above in Figure 9 is the system organization, showing the locations of the power switch, battery holder, velcro, movable button and cover on the handle. There is a connecting rod shaft which links the handle to the claw. The pressure sensor is located on the bottom portion of the claw so that it can detect when contact with the object has been made and the servo motor can stop closing the claw. The image below in Figure 10 shows the battery charger which can be used to recharge the rechargeable batteries by USB for repeated use.

A hand holding a black device

Description automatically generated

Figure 10: Battery charger

## Exiting the System

To exit the system, press the button to open the claw and release any objects currently being grasped. Next, switch the power switch to the off position. If necessary due to extended use, give the grabber to an adult who can remove the batteries and recharge them using the included charger so that the device will be ready for the next use.

# Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions of the Powered Grabber. All of the referenced parts are in the photo at the bottom of this section.

## 4.1 Turning the Grabber On/Off

**Objective:**

* This function allows the user to power the grabber on or off using the battery pack's switch.

**Steps:**

1. Locate the battery pack.
   1. The battery pack is attached to the bottom of the grabber's handle
2. Identify the switch.
   1. On the top of the battery pack, you will see a small toggle switch.
3. Turning the grabber on:
   1. Flick the switch to the "On" position.
   2. Once powered on, the grabber will move to the “Open” position, if it is not already there.
4. Turning the grabber off:
   * Flick the switch to the "Off" position.

## 4.2 Moving the Open/Close Button

**Objective:**

- Allows the user to move the open/close button to their preferred position.

**Steps:**

1. Locate the button.
   1. The button is attached via wire to the back of the handle.
2. Place the button in your preferred spot.
   1. The button has a piece of Velcro attached to it.
   2. The handle also has Velcro all around it.
   3. Place the button via the Velcro connection in your preferred location.

## 4.3 Closing and Reopening the Grabber

**Objective:**

This function allows the user to close the grabber end on any object.

**Steps:**

1. Locate the open/close button.
   1. The button is attached to the back of the handle via wire.
2. Pick up your preferred item.
   1. Place the item within the grasp of the claw end.
   2. Click the open/close button, then wait until the claw stops closing. It will stop automatically once the item is secure.
   3. Move the item to your desired location.
3. Drop the picked-up item.
   1. Place the item over the surface you wish to place it on.
   2. Click the open/close button again.
   3. The claw will slowly open, allowing the item to drop out of its grasp.

A green and black device with a handle and a can of soda

Description automatically generated

Figure 9: System Organization

# Troubleshooting & Support

## Error Messages or Behaviors

If the claw stops opening and closing, please check the following:

* Is the battery pack turned on?
* Are the batteries charged?
* Is the claw visibly jammed?
* Is the button jammed?

If all the above conditions are not an issue, it is likely that there is an internal error with the claw.

Unfortunately, the current prototype does not have a simple fix to this problem and could have stopped working for multiple reasons:

* Wiring snapped / disconnected
* Servo overheated
* Loose / Broken parts

To fix these issues, someone will have to either fix the soldering on the wires, replace the servo, or remount / replace the parts.

## Special Considerations

In the unfortunate scenario where the grabber makes an odd buzzing sound before stopping functionality, it is likely that the servo needs to be replaced. This is due to the servo being too weak and overheating.

To fix this problem, a replacement servo is needed and is unfortunately not simple to fix without the proper tools.

## Maintenance

To ensure that the grabber works for as long as possible, there are multiple things that will help in its longevity:

* Turn off the battery pack whenever the grabber is not in use
* Do not purposely damage the handle
* Do not use the grabber for over 2 hours at a time
* Do not press the button repeatedly in quick succession

# Product Documentation

**Building the Final Prototype**

The final prototype was designed with considerations for mechanical functionality, electrical systems, and software control. Each aspect of the design was approached with usability, sustainability, and functionality in mind. Below is a detailed breakdown of the design and construction process:

1. Mechanical Design

The grabber's mechanical structure consists of a lightweight aluminum frame for durability and portability. The handle and the bottom claw components were 3D-printed to ensure a lightweight and ergonomic design. The claw operates using a rack-and-pinion mechanism driven by a servo motor.

**Key Design Considerations**

Material Choice: Aluminum was chosen over plastic or wood due to its strength-to-weight ratio and corrosion resistance. 3D-printed using PLA material for precision, cost-effectiveness, and ease of customization. Plastic for the frame lacked sufficient strength for long-term use. Wood was heavier and less durable in a humid environment.

Rack-and-Pinion Mechanism: We used an existing mechanism which was a part of a regular grabber tool. We then designed it to efficiently convert rotary motion from the servo motor into linear motion for claw operation. Calculations were performed to ensure the teeth of the rack and pinion matched the torque output of the motor.

Assembly Steps

Frame: Cut and assembled aluminum rods into the desired structure using screws and brackets.

3D-Printed Components: Designed in CAD software (SolidWorks). Printed parts were sanded and fitted for smooth operation.

Rack-and-Pinion Mechanism: Attached the rack to the claw and connected the pinion to the servo motor for reliable operation.

2. Electrical System

The electrical system consists of an Arduino Nano microcontroller, a servo motor, a pressure sensor, and a rechargeable battery system.

Key Design Considerations

* Microcontroller (Arduino Nano): Chosen for its compact size, affordability, and sufficient processing power for the grabber's functions.

Servo Motor: A high-torque servo was selected to handle the mechanical demands of operating the claw. Tested various models to ensure smooth movement without overloading the power supply.

Pressure Sensor: Integrated to provide feedback and prevent the claw from applying excessive force to objects.

Rechargeable Batteries: Chosen for environmental sustainability and long-term cost-effectiveness.

Assembly Steps

Circuit Connections: Connected the Arduino Nano to the servo motor, pressure sensor, and button via a breadboard for initial testing. Once tested, connections were soldered onto the Arduino Nano for durability.

Battery Integration: Connected a rechargeable ‎NiMH battery with a charger for reliable power.

Testing: Verified the electrical system using a multimeter to ensure all components received the correct voltage.

3. Software Control

The Arduino Nano was programmed to control the servo motor and process input from the pressure sensor and button.

**Key Design Considerations**

The software was developed in Arduino IDE with simplicity and modularity in mind.

Implemented a feedback loop for real-time adjustment of the claw’s grip based on the pressure sensor.

**Code Functionality**

Button Press: Activates or deactivates the claw mechanism.

Pressure Sensor Feedback: Adjusts the servo motor's torque to prevent damage to fragile objects.

Error Handling: Includes conditions to reset the claw if unexpected inputs occur.

**Material and Design Alternatives**

Frame Material: Plastic was feasible for cost savings but lacked strength. Steel was too heavy and unnecessarily durable. We ended up choosing aluminum for its lightweight and durable properties.

Claw Material: ABS plastic was more heat-resistant but harder to print with. PLA plastic was chosen for its ease of use and sufficient strength.

Motor Options: A stepper motor was more precise but over-complicated for this application. The DC motors lacked the precision needed for controlled claw movement. Our final selection was a servo motor for balance between simplicity and precision.

**Supporting Files**

3D Models: CAD files for the handle and claw parts (include screenshots or STL files).

Circuit Diagram: A schematic showing connections between Arduino Nano, servo motor, pressure sensor, button, and battery.

Code: Arduino code with comments to explain functionality.

## Claw Mechanism and Control System

### BOM (Bill of Materials)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 3: BOM | | | | | | |
| Description | Quantity | Unit Cost | Extended Cost | Total  (with Tax) | Web Link | |
| Arduino Nano | 1 | $8.00 | $8.00 | $9.04 | <https://makerstore.ca/shop/ols/products/arduino-nano> | |
| Arduino Pressure Sensor | 1 | $13.58 | $13.58 | $15.35 | <https://www.amazon.ca/Pressure-Precise-Force-Sensitive-Resistor-Resistance-Type/dp/B07T1CHY58/ref=sr_1_5> | |
| SG90 Micro Servo Motor | 1 | $9.99 | $9.99 | $11.29 | <https://www.amazon.ca/Servo-Helicopter-Airplane-Remote-Control/dp/B09L525KDT/ref=sr_1_10> | |
| 5ft Hook-up Wire | 2 | $1.60 | $3.20 | $3.62 | <https://makerstore.ca/shop/ols/products/5ft-hook-up-wire-22awg-black> | |
| AAA Battery Holder with On/Off Switch | 1 | $2.50 | $2.50 | $2.83 | <https://makerstore.ca/shop/ols/products/3-x-aaa-battery-holder-with-on-off-switch-and-2-pin-jst> | |
| Push Button (6mm) | 1 | $0.50 | $0.50 | $0.57 | <https://makerstore.ca/shop/ols/products/micro-tactile-button-6mm> | |
| Handle and cover | 1 | $0 | $0 | $0 | 3D-print at makerlab | |
| Grabber Claw | 1 | $0 | $0 | $0 | 3D-print at makerlab | |
| Super Glue | 1 | $0 | $0 | $0 | N/A | |
| Rubber Grip Tape | 1 | $0 | $0 | $0 | N/A | |
| Stick on Velcro strips 4 x 2 inch strips, 8-pack | 1 | $9.06 | $9.06 | $10.24 | [Amazon](https://www.amazon.ca/VELCRO-Brand-Fasteners-Industrial-VEL-30703-USA/dp/B09BNPX3XJ/ref=sr_1_5?dib=eyJ2IjoiMSJ9.e4p__qWRBtPa7c6d5yLLWZFoVLpbljJ_Ii_tddc9DB-q7ICoqCwVQsPYrCk3nDmQYBM1vr1dsRC7Uj6b5iauz9NLxt4NaOQuvRwbqNwsiHlLqHSOHyqWcv0Gp2Op65l_Dv0O_hp6Y02Oy6aKVxgh5M-brRSaolpZFXMzTXaxsdL__1CFMtZ6LURZt2emJFqaiR2rBNxjVwjMStL_IwELhAuVTRbyI_BRQVTD6ULgmmhjyzZ1DGD8O37L4WIjqlmpVBxm2VMBUR0wamJtcMQAq27umhB4vDoZ1FbKjBNkq18.TQ1Gw63ipSIuZ-49KrpTk3zjXqPV9muGo9llwC52LcE&dib_tag=se&hvadid=231074705740&hvdev=c&hvlocphy=9000668&hvnetw=g&hvqmt=e&hvrand=6830081613057367967&hvtargid=kwd-350593924487&hydadcr=20845_10090782&keywords=velcro&qid=1731098854&sr=8-5&th=1) | |
| Roll of Double Sided Tape | 1 | $0 | $0 | $0 | N/A | |
| Manual Grabber | 1 | $3 | $3 | $3.39 | Dollarama | |
| 4-pack Powerowl Rechargeable AAA batteries with charger | 1 | $14.99 | $14.99 | $16.94 | [Amazon](https://www.amazon.ca/POWEROWL-Rechargeable-Batteries-Capacity-Discharger/dp/B09MMYJ98H/ref=sr_1_22_sspa?crid=1V8XR51U9RW3W&dib=eyJ2IjoiMSJ9._UmIKOUpVAYrnOKdQQZeP_c-lmG0vu0a4NQyPYIdJ1caudUrfYypQSJhTqS1iWrDPhd7Fva3f0vnCHx5OcxhAxCD32JxaYmq74_Dizhz27qgxvRBf7A4cyUfmBEVpPSc7hxsm3953InP4Yf1GU5E9zAupJCCCKT1tDa-kEbtBdg5IJWqZ6fLCCTZAp6jFkjjN7QT8c2NO3q5w5YD2TaphFaXYPPEuzFzjZRMKtNQhtk_nv4zUTslPXd3gzOK_jvwto0h4DwatMtHZJK-CSXMmNTuEPieAzpJJYz90MN-o8M.rhbd_H-CbL8eshpzKMPZLIMqRA1gjg7OOTBkl7o95yU&dib_tag=se&keywords=rechargeable+aaa+batteries&qid=1731274771&sprefix=rechargeable+aaa+batterie%2Caps%2C195&sr=8-22-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9tdGY&psc=1&smid=A14DZT87CHDC2N) | |
| Total | 19 |  | | $73.27 | |

Mechanical Equipment

3D Printer For printing the handle and claw components.

Screwdrivers and Wrenches: For assembling the aluminum frame and fastening screws.

Drill and Drill Bits: For creating precise holes in the aluminum frame.

Sanding Tools: For smoothing 3D-printed parts.

Electrical Equipment

Soldering Iron: For creating durable electrical connections.

Multimeter: For testing voltage, current, and continuity in the circuit.

Wire Strippers: For preparing wires for soldering.

Breadboard: For initial circuit testing.

Power Supply or Charger: For powering the rechargeable batteries during testing.

Software Tools

Arduino IDE: For programming the Arduino Nano.

CAD Software (SolidWorks): For designing 3D parts.

### Equipment list

* Soldering Kit
* 3D Printer
* Scissors / Exacto Knife
* Wire Strippers
* Multi-tool (Saw, drill, sander)

### Instructions

**Mechanical Assembly**

3D Printing the Handle and Claw:

* Download or create the STL files for the handle and claw in a CAD tool.
* Load the STL files into your 3D printer software and slice them.
* Print the parts using PLA filament at 0.2mm layer height.
* Sand the printed parts for smooth operation.

Frame Assembly:

* Cut aluminum rods to the required lengths.
* Drill holes in the rods as needed for brackets and fasteners.
* Assemble the frame using screws and brackets, ensuring alignment and stability.
* Rack-and-Pinion Installation:
* Attach the rack to the claw mechanism.
* Mount the pinion gear to the servo motor.
* Test the movement to ensure smooth operation.

**Electrical Assembly**

Connecting Components:

* Solder wires to the Arduino Nano, servo motor, pressure sensor, and activation button.
* Use heat shrink tubing to secure soldered joints.

Building the Circuit:

* Test the circuit on a breadboard to ensure all connections are correct.
* Once tested, transfer the circuit to a PCB for a durable final assembly.

Battery Integration:

* Connect the rechargeable battery pack to the circuit with a charging module.
* Secure the battery to the frame with Velcro straps or brackets.

**Programming**

* Write the code in the Arduino IDE to control the servo motor and read inputs from the pressure sensor.
* Upload the code to the Arduino Nano via a USB cable.
* Test the functionality by pressing the activation button and observing claw movement.

## Testing & Validation

**Tests Conducted**

Mechanical Tests:

* Strength Test: Evaluated the frame’s ability to withstand applied loads (e.g., lifting a water bottle).
* Claw Grip Test: Tested the effectiveness of the claw in gripping various objects.
* Rack-and-Pinion Test: Verified smooth operation without slipping or excessive resistance.

Electrical Tests:

* Power Consumption Test: Measured current draw during operation to ensure battery longevity.
* Pressure Sensor Test: Validated accurate feedback for various grip forces.
* Circuit Reliability Test: Tested the circuit under prolonged use to identify overheating or loose connections.

Software Tests:

* Functionality Test: Ensured that button presses activated and deactivated the claw correctly.
* Feedback Loop Test: Verified real-time adjustments based on pressure sensor inputs.

**Results**

* Grip Strength: Successfully lifted objects weighing up to 1.5 kg without slippage.
* Battery Performance: Operated for 4 hours on a single charge.
* Precision: Pressure sensor provided accurate feedback, preventing over-gripping of fragile objects.

**Issues and Sustained Usage Requirements**

Issues Identified:

* Slight misalignment in the rack-and-pinion during initial assembly, resolved by adjusting gear spacing.
* Overheating of the servo motor after extended use, mitigated by limiting continuous operation to 2 minutes.

Sustained Usage Requirements:

* Regularly check and charge the battery.
* Inspect the mechanical components for wear and lubricate moving parts as necessary.

# Conclusions and Recommendations for Future Work

During this project we learned about the importance of having a proper project plan, time management, research, and more. One of the most important things that we learned while working on this project is the need to properly allocate time for each step of the process. It is always better to have more time than needed than to have too little time. During the project we underestimated how much time each step would take and sometimes did not have enough time to finish each step to the best of our abilities. Thus, we believe that planning ahead and expecting things to take longer than expected would be beneficial for future groups. Also, doing research on related products helped us a lot in figuring out what we want our product to improve on, and what we can change. Rather than trying to think of all our ideas ourselves, we realized that improving on existing ideas was far more efficient.  
 If we had a few more months to work on this project we would add an extension feature and optimize the strength of our grabber. The extension feature would involve allowing the rod of our grabber to change in length, thus allowing customizability to the kids using the grabber. This would help in their comfortability with the product. The strength of our grabber could also be improved with additional time, allowing the grabber to be more reliable than it already is. During our design process, we abandoned the idea of running the wiring of our prototype through the inside of the rod. With more time, we would have been able to accomplish this by either buying, or 3D printing a bigger rod. The lack of time resulted in us having to run the wire outside the rod but could have easily been put inside with more time to find a bigger rod.

# Bibliography

Lakhani, R. (2024). *GNG2101B Fall 2024 Lecture Notes*. Brightspace; University of Ottawa. https://uottawa.brightspace.com/d2l/le/content/454242/Home

APPENDICES

# APPENDIX I: Design Files

MakerRepo link: <https://makerepo.com/IsmailShaheen/2181.gng2101-power-assisted-grabber-group-24>

Table 4. Referenced Documents

|  |  |  |
| --- | --- | --- |
| **Document Name** | **Document Location and/or URL** | **Issuance Date** |
| Grabber Bottom Claw Piece | <https://drive.google.com/file/d/12JmOTJH7BE7ATXYulZm5SrX0JwU30Cs2/view?usp=sharing> | December 2, 2024 |
| Grabber Handle | <https://drive.google.com/file/d/16rkfVzP726YZY0A9nJXw3IQQz7bO1wQz/view?usp=sharing> | December 2, 2024 |
| Grabber Hande Cover | <https://drive.google.com/file/d/1XXtcNJ5EKiNnmN-cYUCq2Y_UeanrcPDR/view?usp=sharing> | December 2, 2024 |
| Grabber Code | <https://drive.google.com/file/d/1cve-h-6nyy943g-4KXw0tkDv2-5fZmg7/view?usp=sharing> | December 2, 2024 |

# APPENDIX II: Other Appendices